U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

15.7.5 SPENT FUEL CASK DROP ACCIDENTS

REVIEW RESPONSIBILITIES

Primary - ~~Accident Evaluation Branch (AEB)~~Emergency Preparedness and Radiation Protection Branch (PERB)[1]

Secondary - ~~Auxiliary Systems Branch (ASB)~~Civil Engineering And Geosciences Branch (ECGB)[2]

~~Effluent Treatment Systems Branch (ETSB)~~Plant Systems Branch (SPLB)[3]

I. AREAS OF REVIEW

The review under this Standard Review Plan (SRP)[4] section covers the radiological consequences of the release of fission products from irradiated fuel in a spent fuel cask that is postulated to drop during cask handling operations. ~~SRP Section 15.7.4 covers the radiological consequences of fuel handling accidents in which an object is dropped onto irradiated fuel resulting in the release of fission products from the stored fuel. SRP Section 15.7.4 also includes the consequences of a fuel cask dropping or tipping onto irradiated fuel in the spent fuel pool.~~[5]

~~The ASB evaluates the spent fuel cask handling system under SRP Section 9.1.4.~~[6]The ~~AEB~~PERB[7] reviewer, as explained below, will verify various design and operations aspects of the system with the ~~ASB~~ECGB[8] as a secondary review branch. The points covered in the ~~AEB~~PERB[9] review are as follows:

~~1. ASB is consulted to verify the potential drop height during handling of a loaded cask and the procedures for handling the cask with respect to the impact limiter. If the handling~~

USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

~~procedures meet all applicable criteria, then the radiological consequences of a spent fuel cask drop accident need not be estimated.~~[10]

~~2.~~1. A design basis radiological analysis is performed if a cask drop exceeding 9.2 meters[11] (30 feet) can be postulated or if limiting devices are removed during cask handling within the plant so the 9.2 meter[12] (30 foot) drop height is exceeded. If the radiological consequences of a cask drop accident are to be computed, then information on whether building leaktightness can be expected after a cask drop is obtained from ~~ASB~~ECGB[13] (e.g., whether the technical specifications require large doors to be closed during fuel handling or whether ventilation systems should be operating and whether the building leaktightness would be violated by the cask drop).

~~3.~~2. The safety analysis report (SAR)[14] and technical specifications are reviewed and the relevant plant parameters are evaluated for incorporation into the dose computation model. The model incorporates conservative transport mechanisms and rates from the fuel release to the atmosphere, suitable breathing rates, dose conversion factors, and other data that may affect the dose. The X/Q data are obtained from the assigned meteorologist.

~~4. The Effluent Treatment System Branch (ETSB) provides the filter efficiencies for the ESF atmospheric cleanup systems to AEB for use in the analysis of the radiological consequences resulting from spent fuel cask drop accidents. This is a secondary review effort by ETSB.~~[15]

~~5.~~3. The calculated doses are compared with exposure guidelines to determine the acceptability of the exclusion area and low population zone (LPZ) distances and to confirm the adequacy of engineered safety features (ESF) provided for the purpose of mitigating potential doses from spent fuel cask drop accidents.

~~6. ASB is consulted for verification that a cask drop or tipping will not damage fuel in either the spent fuel storage building or in the containment building, if applicable. If the handling procedures are such that spent fuel can be damaged, an analysis of the resulting offsite doses will be performed under SRP Section 15.7.4.~~[16]

4. The PERB determines the relationship of the operational modes of the standby gas treatment system (SGTS) to the time sequence of the accident in order to give proper credit, in a dual containment design where the fuel building may be exhausted through the SGTS.[17]

The PERB performs additional related reviews under the following SRP sections:[18]

1. SRP Section 15.7.4 which covers the radiological consequences of fuel handling accidents in which an object is dropped onto irradiated fuel resulting in the release of fission products from the stored fuel. SRP Section 15.7.4 also includes the consequences of a fuel cask dropping or tipping onto irradiated fuel in the spent fuel pool.

2. SRP Section 2.3.4 for determining the acceptability of the atmospheric dispersion factors, X/Q values.[19]

Review Interfaces

The PERB coordinates other branch evaluations that interface with the overall review as follows:[20]

1. The Plant Systems Branch (SPLB) performs the following:

   a. Provides the filter efficiencies for the ESF atmospheric cleanup systems to PERB for use in the analysis of the radiological consequences resulting from spent fuel cask drop accidents.

   b. Provides input for the areas of review stated in subsection I of this SRP section, upon request from the PERB reviewer.

2. The ECGB performs the following:

   a. Provides consultation to verify the potential drop height during handling of a loaded cask and the procedures for handling the cask with respect to the impact limiter. If the handling procedures meet all applicable criteria, then the radiological consequences of a spent fuel cask drop accident need not be estimated.

   b. Provides consultation for verification that a cask drop or tipping will not damage fuel in either the spent fuel storage building or in the containment building, if applicable. If the handling procedures are such that spent fuel can be damaged, an analysis of the resulting offsite doses will be performed under SRP Section 15.7.4.

   c. Evaluates the spent fuel cask handling system under SRP Section 9.1.4.

   d. Provides input for the areas of review stated in subsection I of this SRP section, upon request from the PERB reviewer.

   e. Assists in determining whether radiological consequences of a spent fuel cask drop accident need be evaluated.

For those areas of review identified as part of the primary responsibility of other branches, the acceptance criteria and methods of application are contained in the referenced SRP section.[21]

II. ACCEPTANCE CRITERIA

The ~~AEB~~PERB[22] acceptance criteria for this SRP section are based on the requirements of 10 CFR Part 100 ~~(Ref. 1)~~[23] with respect to the calculated radiological consequences of a spent fuel cask drop accident and General Design Criterion 61 ~~(Ref. 2)~~[24] with respect to appropriate containment, confinement and filtering systems.

1. The plant site and dose mitigating ESF systems are acceptable with respect to the radiological consequences of a postulated spent fuel cask drop accident if the calculated whole-body and thyroid doses at the exclusion area and low population zone boundaries are well within the exposure guideline values of 10 CFR Part 100, paragraph 11. "Well within" means 25 percent or less of the 10 CFR Part 100 exposure guideline values, i.e., 750 mSv[25] (75 rem) for the thyroid and 60 mSv[26] (6 rem) for the whole-body doses.

2. The radioactivity control features of the fuel storage and spent fuel cask handling system in the fuel building are acceptable if they meet the requirements of General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control," ~~(Ref. 2)~~[27] with respect to appropriate containment, confinement and filtering systems.

3. The model for calculating the whole-body and thyroid doses is acceptable if it incorporates the appropriate conservative assumptions in ~~Regulatory Guide 1.25 (Ref. 3)~~NUREG-1465 with respect to gap release fractions and iodine chemical form. ~~inventory as stated in positions C.1.d,e, and f of the guide.~~[28] The acceptability of the atmospheric dispersion factors, X/Q values, is determined under SRP Section 2.3.4.

4. An ESF grade atmospheric cleanup system is required for the fuel handling building to reduce the potential radiological consequences of the fuel cask drop accident.

5. The plant design with regard to spent fuel cask drop accidents is acceptable without calculation of radiological consequences if potential cask drop distances are less than 9.2 meters[29] (30 feet) and appropriate impact limiting devices are employed during cask movements, as determined by ~~ASB~~ECGB.[30]

Technical Rationale[31]

The technical rationale for application of these acceptance criteria to reviewing the radiological consequences of fuel handling accidents is discussed in the following paragraphs:[32]

1. Compliance with 10 CFR Part 100, section 100.11, limits the total radiation dose to the whole body and to the thyroid at the exclusion area and low population zone boundaries given a fission product release from a postulated accident.

   10 CFR Part 100 is applicable to SRP 15.7.5 because of the necessity or calculating the radiological consequences of a postulated fuel handling accident. Appropriate containment, confinement, and filtering systems must be considered in the review of SRP 15.7.5 to determine if the calculated whole-body and thyroid doses at the exclusion area and low population zone boundaries are well within the exposure guidelines of 10 CFR Part 100. NUREG-1465 provides additional guidance in meeting these requirements.

Meeting this requirement provides assurance that radiation dose to the whole body and to the thyroid at the exclusion area and low population zone boundaries are well within the exposure guidelines contained in paragraph 100.11 of 10 CFR Part 100.[33]

2. Compliance with GDC 61 requires, in part, that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions.

   GDC 61 is applicable to SRP 15.7.5 in that the SRP covers the review of the radiological consequences of postulated fuel handling accidents that involve damage to spent fuel. Such postulated accidents include the dropping of a single fuel assembly and handling tool, dropping of a heavy object onto other spent fuel assemblies, or dropping a spent fuel cask. Such accidents may occur inside the containment, along the fuel transfer canal, and in the fuel building. Therefore, appropriate containment, confinement and filtering systems are designed and reviewed to reduce potential fuel handling accident radiation doses to well within acceptable limits.

   Meeting the requirements of GDC 61 provides assurance that the radioactivity control features of the fuel storage and handling systems inside containment and in the fuel building provide adequate safety during normal operations and during postulated accidents.[34]

III. REVIEW PROCEDURES

The reviewer selects and emphasizes specific aspects of this SRP section as are appropriate for a particular plant. The areas to be given attention and emphasis in the review are determined by the similarity of the information provided in the SAR to that recently reviewed on other plants and whether items of special safety significance are involved.

Upon request from the ~~AEB~~PERB[35] reviewer, the ~~ASB~~ECGB[36] and ~~ETSB~~SPLB[37] as secondary review branches will provide input for the areas of review stated in subsection I of this SRP section. The ~~AEB~~PERB[38] reviewer obtains and uses such input as required to ~~assure~~ensure[39] that this review procedure is complete.

The first step in the review procedure is to determine, with the assistance of the ~~ASB~~ECGB[40] as described in subsection I, whether radiological consequences of a spent fuel cask drop accident need be evaluated. If a radiological consequence calculation is found to be necessary, the procedure is as follows:

1. The fuel element gap inventory is determined in a manner similar to that for a fuel handling accident ~~(see Ref. 3)~~(see NUREG-1465).[41] The differences are that a longer decay time is allowed (earliest time after reactor fueling that a cask loading operations commence) and the number of fuel elements involved is based on the largest capacity cask available or projected to be available.

2. If the drop is assumed to occur inside the refueling facility at a time when the facility is closed, and ESF-grade charcoal filtration is available, credit may be allowed for iodine

filtration. For the filters themselves, verification of acceptability and efficiencies is provided by the ~~ETSB~~SPLB.[42] In a dual containment design where the fuel building may be exhausted through the standby gas treatment system (SGTS), ~~AEB~~PERB[43] determines the relationship of the operational modes of the SGTS to the time sequence of the accident in order to give proper credit.

3. If the spent fuel drop is assumed to occur at a time when the facility is open to the outside atmosphere, an untreated puff release is assumed.

4. If a spent fuel cask is utilized in a containment structure which is not isolated during fuel cask transfer and ~~ASB~~ECGB[44] has determined that cask drop or tipping on spent fuel can occur, the radiological doses from all failed fuel will be evaluated.

5. The assigned meteorologist furnishes suitable X/Q values to determine the consequences of the accident. X/Q values are obtained for the exclusion area boundary and the boundary of the LPZ.

6. The relevant plant parameters and the X/Q values are used to compute doses. The doses due to a postulated spent fuel cask drop accident are calculated at the exclusion area boundary and the boundary of the LPZ.

7. The calculated doses are compared with the acceptance criteria in subsection II. Where results of the dose calculations indicate the guidelines may be exceeded, the applicant will be requested to modify the design or procedures which would reduce the doses to acceptable levels.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[45]

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided by the applicant and the staff's independent dose calculations to support conclusions of the following type, to be included in the staff's safety evaluation report (SER)[46] for the case that the cask drop height is 9.2 meters[47] (30 feet) or more:

> The staff finds that the applicant has provided an adequate system to mitigate the radiological consequences of a postulated spent fuel cask drop accident in the fuel building. The staff concludes that the spent fuel cask drop accident is acceptable and

meets the relevant requirements of General Design Criterion 61. This conclusion is based on the following:

The staff concludes that the distances to the exclusion area and to the low population zone boundaries for the (INSERT PLANT NAME) site, in conjunction with the operation of dose mitigating ESF and implementation of plant procedures, are sufficient to provide reasonable assurance that the calculated offsite radiological consequences of a postulated spent fuel cask drop accident are well within the 10 CFR Part 100 exposure guidelines.

The staff's conclusion is based on (1) the staff's determination that the design features and plant procedures at the (INSERT PLANT NAME) facility meet the requirements of General Design Criterion 61 with respect to radioactivity control, (2) the staff review of the applicant's assumptions and analyses of the radiological consequences from the spent fuel cask drop accident, and (3) the staff's independent analysis using conservative assumptions including those in ~~Regulatory Guide 1.25 Position C.1.d, e, and f~~NUREG-1465[48] with respect to gap inventory.

If the cask drop height is less than 9.2 meters[49] (30 feet), this will be stated in the ~~AEB~~PERB[50] ~~Safety Evaluation Report~~SER,[51] but no evaluation finding with respect to radiological consequences need be included.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[52]

V. IMPLEMENTATION

The following provides guidance to applicants and licensees regarding the staff's plans for using this SRP action.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[53] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[54]

VI. REFERENCES

1. 10 CFR Part 100, 100.11, "Determination of Exclusion Area, Low Population Zone, and Population Center Distance."

2. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."

3. Regulatory Guide 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors."

4. NUREG-1465, February 1995, "Accident Source Terms for Light-Water Nuclear Power Plants."[55]

SRP Draft Section 15.7.5
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB name and abbreviation	Changed PRB to Emergency Preparedness and Radiation Protection Branch (PERB).
2.	Current SRB name and abbreviation	Changed SRB to Civil Engineering And Geosciences Branch (ECGB).
3.	Current SRB name and abbreviation	Changed SRB to Plant Systems Branch (SPLB).
4.	Editorial	Defined SRP.
5.	SRP-UDP format item	Relocated to item 1 under additional related review responsibilities of PERB.
6.	SRP-UDP format item	Relocated to "Review Interfaces," subsection 2.c.
7.	Current PRB abbreviation	Changed PRB to PERB.
8.	Current SRB abbreviation	Changed SRB to ECGB.
9.	Current PRB abbreviation	Changed PRB to PERB.
10.	SRP-UDP format item	Relocated to "Review Interfaces," subsection 2.a.
11.	SRP-UDP format item, convert to metric units	Converted feet to meters.
12.	SRP-UDP format item, convert to metric units	Converted feet to meters.
13.	Current SRB abbreviation	Changed SRB to ECGB.
14.	Editorial	Defined SAR.
15.	SRP-UDP format item	Relocated to "Review Interfaces," subsection 1.a.
16.	SRP-UDP format item	Relocated to "Review Interfaces," subsection 2.b.
17.	SRP-UDP format item	Excerpted from subsection III.2.
18.	SRP-UDP format item	Added other related SRP sections reviewed by the primary reviewer.
19.	SRP-UDP format item	Added related SRP section reviewed by the PERB identified in last sentence of acceptance criterion 3.
20.	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW and organized in numbered paragraph form to describe how PERB reviews aspects of the spent fuel cask drop accident under other SRP sections and how other branches support the review of the spent fuel cask drop accident. "Review Interfaces" were relocated from subsection I, AREAS OF REVIEW, and excerpted from subsection III, REVIEW PROCEDURES.

Item	Source	Description
21.	SRP-UDP format item	Revised to reflect the current format when the SRP contains review interfaces.
22.	Current PRB abbreviation	Changed PRB to PERB.
23.	SRP-UDP format item	Deleted (Ref. 1).
24.	SRP-UDP format item	Deleted (Ref. 2).
25.	SRP-UDP format item, convert to metric units	Converted rem to mSv.
26.	SRP-UDP format item, convert to metric units	Converted rem to mSv.
27.	SRP-UDP format item	Deleted "(Ref. 2)."
28.	Integrated Impact number 848	Deleted the reference to Regulatory Guide 1.25 (Ref. 3) and cited, instead, "NUREG-1465" to accommodate Integrated Impact 848. See also, SECY-94-300.
29.	SRP-UDP format item, convert to metric units	Converted feet to meters.
30.	Current SRB abbreviation	Changed SRB to ECGB.
31.	SRP-UDP format item, develop technical rationale	Added "Technical Rationale" to ACCEPTANCE CRITERIA and organized in numbered paragraph form to describe the bases for referencing the GDC.
32.	SRP-UDP format item, develop technical rationale	Added lead-in sentence for "Technical Rationale."
33.	SRP-UDP format item, develop technical rationale	Added technical rationale for 10 CFR Part 100, section 100.11.
34.	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 61.
35.	Current PRB abbreviation	Changed PRB to PERB.
36.	Current SRB abbreviation	Changed SRB to ECGB.
37.	Current SRB abbreviation	Changed SRB to SPLB.
38.	Current PRB abbreviation	Changed PRB to PERB.
39.	Editorial	Replaced assure with ensure.
40.	Current SRB abbreviation	Changed SRB to ECGB.
41.	SRP-UDP format item and Integrated Impact 848	Deleted citation (see Ref. 3) and added the new reference title "NUREG-1465" to accommodate Integrated Impact 848.
42.	Current SRB abbreviation	Changed SRB to SPLB.
43.	Current PRB abbreviation	Changed PRB to PERB.

Item	Source	Description
44.	Current SRB abbreviation	Changed SRB to ECGB.
45.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
46.	SRP-UDP format item	Provided the acronym (SER) for safety evaluation report.
47.	SRP-UDP format item, convert to metric units	Converted feet to meters.
48.	Integrated Impact number 848	Deleted reference to RG 1.25 and replaced with NUREG-1465 to accommodate Integrated Impact 848. See also, SECY-94-300.
49.	SRP-UDP format item, convert to metric units	Converted feet to meters.
50.	Current PRB abbreviation	Changed PRB to PERB.
51.	Editorial	Replaced "safety evaluation report" with its acronym SER.
52.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items.
53.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
54.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
55.	Integrated Impact number 848	Added a new Reference 4 to Subsection VI, to cite NUREG-1465, to accommodate Integrated Impact 848. See also, SECY-94-300.

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SRP Draft Section 15.7.5

Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
848	Revise acceptance criteria and review procedures to incorporate the application of revised source term data.	SRP Section 15.7.5, Subsections II.3, III.1, and VI